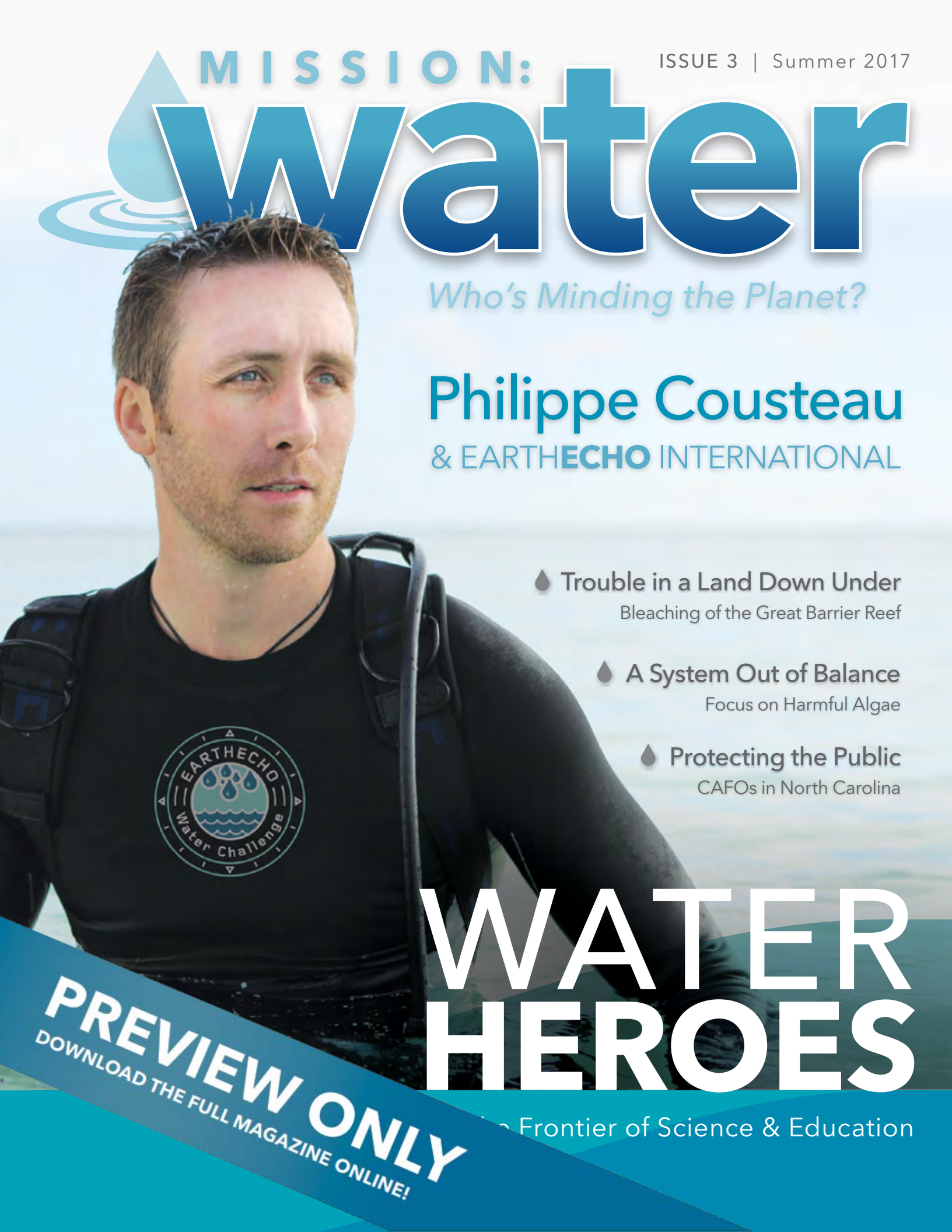
ISSUE 3 | Summer 2017

MISSION: water

Who's Minding the Planet?

Philippe Cousteau
& EARTHECHO INTERNATIONAL



- **Trouble in a Land Down Under**
  Bleaching of the Great Barrier Reef
- **A System Out of Balance**
  Focus on Harmful Algae
- **Protecting the Public**
  CAFOs in North Carolina

WATER HEROES

...e Frontier of Science & Education

In this Issue

I'm excited to report that **Mission: Water** is emerging as a significant forum for those with a passion for protecting our most valuable resource–water. And as always, I'd like to thank all of the contributors to this and previous editions who have shared their stories, science and expertise. Without your involvement, this publication would not be possible.

In our 3rd edition we highlight the exceptional work of EarthEcho and its founder, Philippe Cousteau. It's a truly inspirational story of how a strong will and vision can engage the next generation of environmental stewards. We also continue to cover stories from across the globe, including grassroots efforts to monitor Concentrated Animal Feeding Operations (CAFOs), high speed monitoring on the Baltic Sea, and much more!

We hope you enjoy the magazine. Let's continue to solve the world's most challenging water issues, "**Let's Solve Water**".

Timothy A. Grooms

Timothy A. Grooms
Director of Marketing - Xylem Analytics, NA

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#WaterHeroes

Sailing the Baltic Sea

Measuring Environmental Effects of Shipping

DR. ANDERS TENGBERG

For several thousand years, the Baltic Sea has been an important resource for fishing and trade. The Vikings (800-1100 AC) established trade routes across the Baltic and travelled with their longships via rivers to the Caspian and Black Seas. Many of the Viking trade routes and locations were eventually taken over by the Hanseatic League, an association of independent cities that dominated trade and shipping in Northern Europe during the Middle Ages.

Today other types of ships dominate the Baltic Sea - from ferries and cruise ships, to oil tankers, car carriers, container and other cargo ships. Up to 15% of the world's cargo traffic is handled in the Baltic Sea, making it one of the busiest areas for ship traffic, in the world. Due to its narrow straights and shallow waters, the Baltic Sea is difficult to navigate. In some of the major ship lanes, like in the Bornholm straight between the Danish Island of Bornholm and the Swedish main land, there is one large ship passing every 10 minutes, on average. [1]

The ever expanding shipping and tourism industries have led to growing environmental pressure on the waterway. This pressure manifests as increased air, water, and noise pollution, presenting a clear threat to the future of the Baltic. So much that the European Union (EU) launched a joint research and development program called **BONUS** in 2010, focused exclusively on developing a sustainable economic and ecological plan for commerce.

BONUS is a collaboration of representatives from all EU members bordering this priceless resource and "...funds projects of high excellence and relevance to produce knowledge, scientific evidence and [innovative] solutions needed by policymakers..." [2]

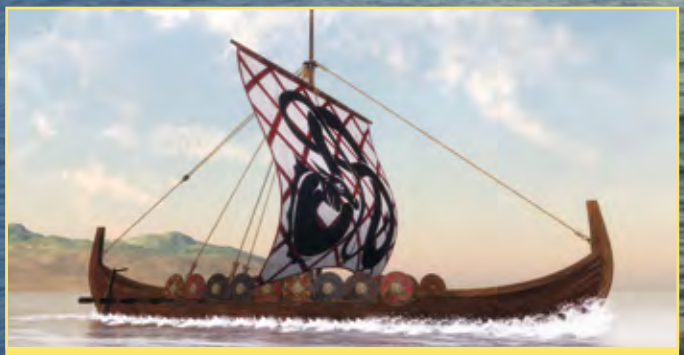
One such initiative is the **SHEBA** (Sustainable Shipping and Environment in the Baltic Sea region) project, which launched in April of 2015 and will continue until 2018. In the SHEBA project, environmental effects of shipping in the Baltic Sea region are in sharp focus. The project is supported by a wide range of stakeholders - from atmospheric and oceanographic scientists to economists and experts on shipping, environmental policies and law, who will be consulted about data collection and results of the project. Per BONUS, the project aims to "...provide a holistic assessment of [the] impacts of operational shipping on the environment...through [analysis] of the drivers for shipping and their impacts on ship traffic volumes and emission factors." [3]

BONUS Members

Per BONUS, Eight EU (European Union) member states have supported the program with €100M in combined funding over the past 6 years. The Russian government also joins in the program via bilateral agreements. [2]

Denmark Estonia Finland Germany

Latvia Lithuania Poland Sweden Russia



Baltic Vessels of the Past

Mankind has rich maritime history on the Baltic Sea. Kingdoms, merchant leagues, and empires were forged and lost on its waves. Different eras of history led to different naval designs, with some of the most famous designs firmly imprinted into our culture today. Long and slender Viking longships are some of the most easily recognizable ships on record.

Taking cues from the Baltic's past, Hrimfare af Ranrike's name was inspired by Nordic mythology. It translates loosely to frost traveler of the sea, with "Hrim" meaning frost, "Fare" meaning travel and "Ranrike" signifying the kingdom of goddess of the sea (her name was Ran).

[1] Madjidian et al. 2013 [2] bonusportal.org [3] sheba-project.eu

> "The project aims to...provide a holistic assessment of [the] impacts of operational shipping on the environment..."

SHEBA

The *Hrimfare af Ranrike*, a former long distance sailing vessel with no engine emissions.
Photos: Dr. Martin Hassellöv

Charting a Course

A significant portion of SHEBA focuses on gaining a better understanding of pollution. Last year, a 20m (67ft) long, former long distance race yacht was converted into a mobile science lab on water and has served in the SHEBA project to sample for water and air quality conditions in heavily travelled ship lanes. Using the *Hrimfare af Ranrike*, a sailing vessel with no engine emissions, removed the potential problem of self-contamination and possible impacts on the accuracy of the measurements.

During the 2016 summer expedition, the boat was packed with equipment to measure and collect samples in the atmosphere and in the water as it roamed the Baltic Sea, crossing ship lanes perpendicularly. A cluster of surface skimming sensors were attached to a stainless steel pole and mounted about 1m below the surface in the stern of the boat such that measurements were undisturbed by the boat itself as it advanced. The sensors collected data on dissolved oxygen, salinity, temperature, pH, pCO2 (carbon dioxide partial pressure; the partial pressure of carbon dioxide, a measure of the relative concentration of the gas in air or in a fluid) and oil. A **SmartGuard sensor hub** was placed in the forward sail locker to record data from the sensors and the ship's GPS every 20 seconds.

As the *Hrimfare* crossed ship lanes, changes in most of the measured parameters could be clearly detected. Differences in the surface water inside and outside the shipping areas lanes could be attributed to the mixing of the upper ocean by the large vessels. These ships also expel engine cooling and scrubber water, as well as wastewater from the crew living onboard, which affect the water quality of the sea.

To gain a better understanding of the mixing occurring in deeper layers, caused by the ships traffic, Hrimfare stopped at regular intervals to deploy a **SonTek CastAway CTD**. This hand-operated device has built-in GPS for geospatial mapping of salinity, temperature and depth measurements. Each stop included two to three consecutive profiles and took less than five minutes.

Two self-recording acoustic profiling instruments were also dropped below the ship lanes to measure currents in thin layers from the bottom to the surface. The instruments also measure salinity, temperature, dissolved oxygen and suspended particles (turbidity) and are typically deployed for 6-12 months, recording data at least every hour.

Continuous air measurements were done by mounting a sampling tube in the mast through which air was pumped into a set of instruments installed below the deck. The measured parameters included CO_2, NO_x, SO_2, size-resolved particulate matter (PM) and soot (black carbon). Initial analysis of the data showed that signatures of exhaust plumes from individual ships could be identified for the measured gases and particles. For example, when passing a scrubber-equipped ship, clear signals for NO_x, CO_2 and PM could be detected. The air pollution from nearby land regions could also be detected. These measurements are similar to those done in urban areas when studying air pollution from traffic and industry.

Check out more information on the *Hrimfare af Ranrike* at **hrimfare.com**

BONUS research expedition team members.
Photos: Dr. Martin Hassellöv

SonTek CastAway CTD deployed via a fishing rod at regular intervals.

Racing to the Finish

As the SHEBA project nears its completion, the data from vessels like the Hrimfare af Ranrike are critical to making sound policy decisions going forward. With a better understanding of how the shipping sector is impacting the air and water in the region, stakeholders expect to see heightened regulations related to ballast water pollution and waste discharge, among other drivers. This policy change would likely be matched with tighter enforcement and an increased effort to boost adoption of eco-friendly technology within the commercial shipping industry.

The long-term solution to environmental stress in the Baltic Sea is to incorporate emission reduction as a fundamental pillar of future industrial ship designs, whether that is through enhanced waste management, inclusion of alternative propulsion methods, or more efficient use of existing style engines. This is no simple task, but if the SHEBA project is any indication of the power of multinational cooperation, then we are on the right path.

For more about the SHEBA project please visit: **sheba-project.eu**

Aanderaa SmartGuard Hub

Monitoring water and weather conditions is essential in many sea-based operations and the **SmartGuard node** is well suited for stand-alone stations powered by battery and solar power, utilizing wireless real-time data communication.

The **SmartGuard Hub** easily integrates new and existing sensor technologies into a single Aanderaa observatory node with modern, self-describing XML data output formats. The HUB can connect up to 25 sensors for water quality and meteorological studies.

Aanderaa SmartGuard housed in the forward sail locker.

SOOGuard *a flexible and easy to operate FerryBox system*

- Very easy to install and operate
- Minimal maintenance required
- Cost effective to run
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- No programming skills required
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For more on the SOOGuard platform:
aanderaa.info@xyleminc.com • **aanderaa.com**

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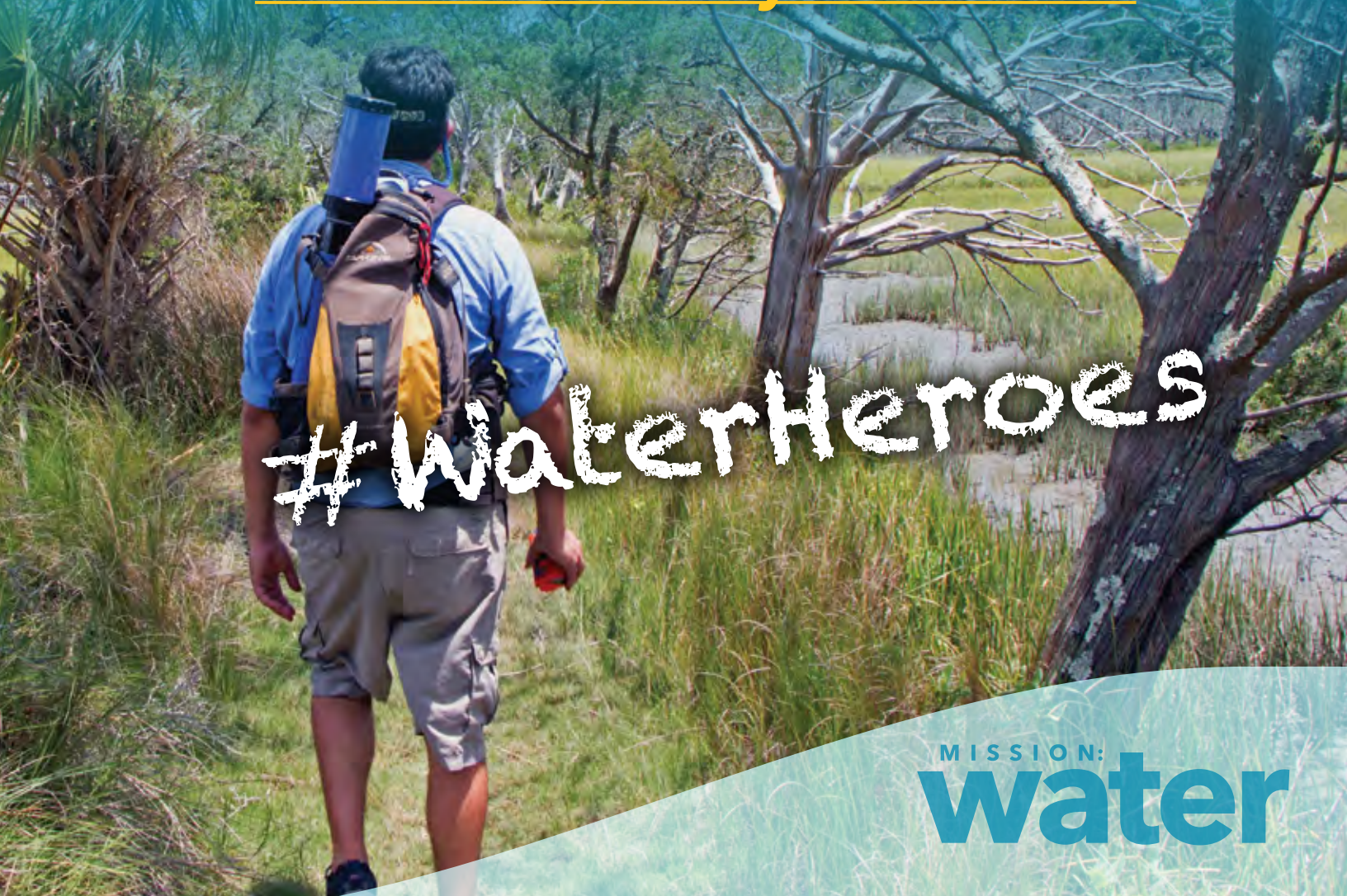

Xylem |'zīləm|

1) The tissue in plants that brings water upward from the roots;
2) a leading global water technology company.

We're a global team unified in a common purpose: creating advanced technology solutions to the world's water challenges. Developing new technologies that will improve the way water is used, conserved, and re-used in the future is central to our work. Our products and services move, treat, analyze, monitor and return water to the environment, in public utility, industrial, residential and commercial building services, and agricultural settings. With its October 2016 acquisition of Sensus, Xylem added smart metering, network technologies and advanced data analytics for water, gas and electric utilities to its portfolio of solutions. In more than 150 countries, we have strong, long-standing relationships with customers who know us for our powerful combination of leading product brands and applications expertise with a strong focus on developing comprehensive, sustainable solutions.

For more information on how Xylem can help you, go to www.xylem.com

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ECO CALCULATIONS REPORT

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